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CONSEIL PERMANENT INTERNATIONAL
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HARRY M. KYLE

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DESIGNED TO FISH IN MIDWATER AS WELL AS ON THE GROUND

PRELIMINARY NOTICE

EN COMMISSION CHEZ
ANDR. FRED. HØST & FILS
COPENHAGUE

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BY

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In a recent contribution to the subject of fishing nets ("Fishing Nets; with special reference to the otter-trawl"; Jour. Mar. Biol. Assoc. Ser. II, vol. VI, No. 4) the various forms of fishing apparatus at present in use have been mentioned, and a detailed description is given of the latest and most powerful instrument of fishing — the otter-trawl. It was there pointed out that the latter is far from being a perfect apparatus, and that so far as scientific aims are concerned the old beam-trawl is in many cases the better instrument of the two. As the advantages and disadvantages of these nets are of importance to the comprehension of the principles on which the new net has been constructed, I may be allowed to refer to them briefly.

The advantages of the beam-trawl over the otter-trawl are:

(1) that it is more easily worked,

(2) that it is more adaptable to scientific purposes.

With regard to (1), the beam-trawl is simpler in construction. There is more to learn about an otter-trawl and its working, consequently greater care and skill are necessary for its use.

The beam-trawl again is more adaptable to scientific purposes because it has a definite and calculable size and can be altered and experimented with more easily than the otter-trawl.

On the other hand, the otter-trawl has the advantage that it can be made much larger than the beam-trawl. Further, as it is more complex in structure, experienced and capable fishermen can adapt it better to the various kinds of fishing. It is therefore of greater use commercially than the beam-trawl.

The disadvantages of both these trawls — considering them together — are:

(1) they are purely ground trawls and cannot fish properly except when on the ground;

(2) they are wasteful as regards material — more particularly the otter-trawl;

(3) they are destructive to small flat-fish.

With regard to (1), the length of the large trawls, beam or otter, when measured along the side is over 100 feet (30 metres). The weight of this net is considerable, so that unless it is flat on the ground when being towed, the hinder part droops down and the passage backwards to the cod-end is closed. These nets are therefore not adapted to fishing in midwater. If the net could be buoyed up sufficiently above and the shape somewhat altered, the otter-trawl might be used in midwater but not so the beam-trawl.

With regard to (2), since the whole length of the net — except perhaps a portion of the belly and batings — is rubbing on the ground whilst fishing, the net gets worn out quickly and is readily damaged. The wear and tear of the net is a very considerable item on the expense list of most boats and even the most careful fishermen have to renew their trawls at least twice a year.

In addition to the great wear and tear of the net, the strain on the boat and engines, coal consumption etc. have also to be considered. The weight of a large otter-trawl with warps is over two tons (2000 klg.) when out of the water. When dragged over the ground, the resistance of the water and ground against the boards and net constitute a great strain in addition to the weight of the trawl itself. This strain, when expressed in terms of coal consumption and repairs to boat, is very considerable indeed. With regard to the resistance offered by the net to the water, it may be said that a great deal lies in the shape and make of the net. That a net is by no means a simple affair is shewn by the numerous patents which are constantly appearing for one thing or another. A recent one taken out at Grimsby claims that by simply altering the ordinary method of making ("braiding") the net, a larger flow is given it with less resistance to the water. Consequently, less power is required to draw it through the water and a saving is affected in machinery and fuel. The question of how to reduce the resistance and the strain on the boat, is indeed one of the greatest importance to the practical fishermen.

The third disadvantage referred to above, viz. the capture of small flat-fish and their consequent destruction, depends upon the first. The lower part of the net is on the ground, the upper part is free. Round fish such as cod and haddock, naturally strike upwards when

disturbed and the small immature specimens readily make their escape through the wide meshes of the top of the net (vide l. c. p. 18 'addance copy', and T. Wemyss Fulton, Scott. Fish. Board Report, XIX for 1900, part III, p. 62). It is otherwise with flat-fish, especially plaice. These strike downwards when disturbed. Consequently when flat-fish which the ground rope has stirred up, have swum a short distance they go *down* not up, and try to cover themselves with sand. As the meshes of the net, however, are quite close to the ground, the fish cannot well pass through and are repeatedly stirred up, until the whole of the net has been drawn underneath them and they are trapped in the cod-end.

Having thus briefly displayed the advantages and disadvantages of the common trawls, it is now possible to state the problems yet to be solved. What we should like to discover is, a net which will be of a definite calculable size, which will fish anywhere — surface, midwater or on the ground, and which if fishing on the ground, will allow small flat-fish as well as small round fish to escape. In order to accomplish the last condition some portion of the lower half of the net must be up off the ground. Finally, if such a net is to be of use to the practical fishermen, it must either increase the catching power of the ordinary trawls without increasing their expense, or on the other hand if not increasing the catching power at least reduce the expense.

In the following pages I propose to give a brief preliminary description of a new trawl which attempts to solve these problems. It has been designed by myself and the first trawl was constructed during this past summer at the works of the "Coal, Salt and Tanning Company" of Grimsby. One experiment only has so far been made with it, and this on the Grimsby steam trawler "Wren" during October 1903, and I was very fortunate in securing the best possible assistance from every one. The experiment though not entirely successful demonstrated that the net could be worked and is a possible net for the future. As it may be of use in the international work of exploration I have thought it advisable to request the Bureau to publish his brief notice here.

Principle of the Trawl: The principle on which the new trawl works is that of the umbrella. The mouth of the net will approximate therefore to a circle, giving the largest areal opening possible.

The reason why large circular nets have not been used much hitherto has been the difficulty of working them — getting them in and out of the boat. By adopting the principle of the umbrella we get over this difficulty, and have a net which can lie as snugly on a boat as a large beam- or otter-trawl and be as easily worked as either, though very much larger in size.

In this trawl there is a central rod surrounded by ribs and over the latter is stretched the net. The ribs are supported by stays which work on joints attached to the ribs, and at their inner ends these stays are fastened to a ring which slides up and down the central rod or towing warp. A large ring or hoop is placed at the posterior end where the ribs converge, and is fastened to the central rod by fixed stays. To this ring the ribs are jointed. The net, which extends

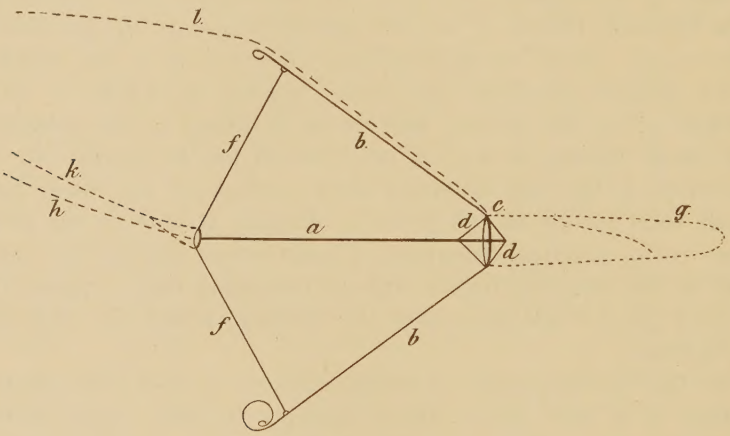

Fig. 1.

over the ribs, is also attached to the ring and likewise the bag or cod-end which terminates the net posteriorly.

Fig. 1 is a diagrammatic section of the net when open (scale, $1^1/_2$ mm = 1 foot = ·3 m)

a central rod,
b two of the ribs jointed to
c the ring or hoop, and to
f the stays.
d the short stays which support ring.
g cod-end.
h main towing-warp attached to central rod.
k the closing warp attached to closing ring and to main towing warp.
l the lifting warp attached to ring (*c*) and to main towing warp, for lifting ring to side of boat.

These are the essential components of the net. The number and length of the rods, ribs etc. may vary within wide limits and the network varies accordingly.

The framework was entirely of steel, the central rod being 2 inches (5 cm) in diameter and the ribs 1 inch (2·54 cm). The other parts were in proportion. The weight of the first trawl constructed was between 10 and 12 cwt (500 to 600 kg). As the ordinary English otter-trawl is about twice this weight we might increase the strength of this framework or the size of the net and still not have so much strain on the ship and towing-lines.

The first trawl constructed was slightly different from that represented in the sketch. The ribs extended 10 to 15 feet (3 to 4·5 m) beyond the stays. Six ribs were employed, the distance allowed between each when fully extended i. e. the length of the head-lines and ground rope, being 20 feet (6 m).

These have been altered for the second experiment. The extensions of the ribs beyond the stays have been done away with, as they are not strong enough to resist unsupported the strain of the water. Instead of 6 ribs, 5 are now being used in order to permit of a longer ground-rope and thus a wider spread when the net is used on the ground.

The head-ropes (which extend between the tips of the upper ribs) and ground-rope were of the ordinary make except that the latter had no steel warp in centre. The net-work was made in six pieces and laced on to the ribs. The cod-end differed only slightly from the ordinary cod-ends in having an extra piece of netting to aid in the formation of the pockets.

In order that the net should be well-balanced it has to be well buoyed up above and weighted below. When towed fast through the water it tends to take up a horizontal position, i. e. with its mouth vertical. When towed on the ground, however, there will be a tendency for the ring to droop downwards. This is prevented in two ways, by means of buoys attached to the top of the ring and also by the upper lifting warp (*l*), which has to be of just such a length that it takes part in towing the net. A buoy is also attached to the top rib and one to the cod-end.

To weight the net, broad iron shoes are fastened to the front part of the two under ribs, and iron bars may be attached to the ground-rope. By arranging the buoyage and weights in this manner, only the front part of the lower ribs and lower portion of the net should be on the ground. Experiment only, however, can really determine whether this is the case or not.

Mode of working the trawl: When placed on the trawler, the ring with cod-end was carried close to the forward gallows, and the towing warps attached to the net over the aft gallows. After fixing the warps, buoys etc. in position, the ring was hoisted over the rail by the fore-tackle, and a running rope attached to it. The tackle was then set free. The towing warp was then pulled up tight, which brought the rod and ribs on to the rail whence they were easily shoved overboard. The ring was then set free and the trawl allowed to sink. As it sank it opened of its own weight. The ship was then set in motion veering round towards the side on which the net was, and the warp payed out in the ordinary fashion. There was no danger of the warp fouling the propeller, but of course the ship was well handled.

On pulling up, the lifting warp was unshackled from the main warp and carried forward over the forward gallows to the drum of the winch. Before hauling on this, however, the closing warp was also unshackled from the main warp and shackled on to the second main warp of the winch. (We were only using one of the warps, it will be remembered.) The closing warp was then pulled tight and both it and the main towing warp hauled in until the net was near the side. The lifting warp was then hauled in forward until the ring came up to the rail, when the foretackle was hooked on and the ring lifted inboard.

The first experiment, as already mentioned, demonstrated that the net could be easily worked on board a trawler, and this was the essential thing to be discovered. A mistake was made however, in not having a swivel on the towing warp which was a new one, with the result that when the trawl reappeared it shewed signs of having been twisted round and towed on its back. The presence of several dabs (*P. limanda*), sea-urchins and star-fishes in the cod-end shewed that the net had been fishing before this occurred.

Comparison with the otter- and beam-trawls: The nature and size of the openings of the various trawls are represented in fig. 2, *a*—*d* (Scale, ·66 mm = 1 foot = ·3 m). Fig. 2 *a* represents a beam-trawl of the largest make. Its opening does not exceed 200 square feet (18 m^2) and is seldom over 160 sq. ft. The size of the otter-trawl (fig. 2, *b*) is not so easily determined. According to Fulton (l. c. p. 120, 121) the actual width of the opening of the trawl is from one half to two thirds of the possible spread, for a large trawl therefore 45 to 60 feet (13·5 to 18 m). As to its height there is great uncertainty. At the sides it is only 4 to 4½ feet (1·3 to 1·35 m), and in the centre it varies greatly according to the speed of the boat and mode of fixing the trawl. The general estimate of the fishermen is that it may be

10 feet (3 m) from the ground. If we take 7 feet (2·1 m) as the average height and 60 feet (18 m) as the breadth we see that the area of the opening is about 420 square feet (37 m²).

A diagrammatic sketch of the opening of the first trawl of the new pattern made is shewn in fig. 2 *d*. The form is very approximately that of a regular hexagon, each side of which is 18 feet (5·4). Its area is therefore about 850 square feet (75 m²) or more than double that of the otter-trawl. When used in mid-water fishing this hexagonal form is to be recommended. It must be remembered also that this is a comparatively small example of the new trawl. On the largest steam-trawlers there is a distance of over 60 feet (18 m) between the gallows, and this would allow a trawl of over 2000 square feet (180 m²) opening to be used. When used for ground-fishing the form represented in fig. 2 *c* is the better, as it gives a greater spread on the bottom. This form is fig. 2 *d* with one of the triangles cut off, i. e. its

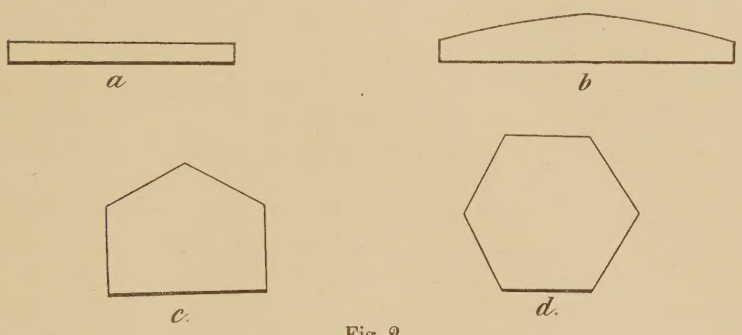

Fig. 2.

area is 850 — 130 = 720 square feet (65 m²) approximately. Its greatest height is about 27 feet (8 m). Even with these small trawls of the new pattern therefore, we have an opening much larger than with the otter-trawl, and four times larger than with the beam-trawl.

Its other advantages are obvious. It can be used to fish at any depth. We may thus be able to ascertain the fish population of the mid-water layers, and determine for example, whether the herring live mostly on the bottom or up in the water, whether the round fish such as cod, haddock and whiting swim in mid-water in any proportion, and at different seasons of the year and so on.

As only one main trawl warp is used we can fish with it at greater depths than the large otter-trawls.

Since the net is on a fixed framework, the size of the mesh can be altered at will without interfering with the fishing qualities of the net. It is possible, for example, to employ a small mesh so as to

capture herrings, or shrimp-netting even, for crustacea such as *Pandalus borealis*.

Again, the size of the meshes on the under part of the net can be increased so as to let the small flat-fish escape. This is rendered possible by having the hind portion of the net off the ground.

It can also be more easily 'standardized', and lends itself to scientific experiments more easily and better than either the otter- or beam-trawl. Its advantages from the practical fisheries standpoint need not be considered here.

Ont paru dans la même série **(PUBLICATIONS DE CIRCONSTANCE)**:

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The Literature of the Ten Principal Food Fishes of the North Sea. In the form of compendious monographs. 108 p. 10 pl. August 1903. Kr. 3.

N° 4—5. Martin Knudsen, Ueber den Gebrauch von Stickstoffbestimmungen in der Hydrographie.

— — , Gefrierspunkttabelle für Meerwasser.

Zusammen 13 S. September 1903. Kr. 0,75.

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